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## Chapter 13

### OVERVIEW OF KEY CONSERVATION ACTION STRATEGIES

Consistent with the Joint Cabinet’s draft State Salmon Strategy (Appendix 1), the Lower Columbia Steelhead Conservation Initiative (LCSCI) provides a comprehensive approach to address the wide variety of fish stocks, risks to stock health, priorities, action opportunities, and constraints relevant to wild steelhead restoration needs in the lower Columbia River. The purpose of this chapter is to present a synopsis of the overarching conservation features of the LCSCI for the following categories: fish management, habitat, and dams/hydropower. Complete details of conservation measures are presented in the three subchapters in Chapter 14, which are also organized by priority Tier in Chapter 15. This chapter draws upon those details to profile key conservation themes and points of emphasis in the LCSCI.

#### Fish Management

Fish and hatchery management strategies for steelhead address relative risks in response to the wide range of stock status circumstances, conservation objectives and utilization interests. Utilization must be consistent with protection and restoration needs. Provision of fishing opportunities for hatchery steelhead must also be consistent with any constraints imposed by NMFS’ administration of the ESA regarding “direct take” of listed species. Specific issues and options regarding fishery management and ESA “take” provisions remain to be resolved.

Management and conservation actions will be applied to waters at various geographic scales, such as entire watersheds, substantial tributaries, or sections within watersheds. Thus multiple types of conservation actions may be applied within individual watersheds or basins, and perhaps within stocks. When implemented in the aggregate however, emphasis will be placed on ensuring the health of stocks comprising the ESUs throughout the scope of the LCSCI. In developing conservation measures for individual stocks, factors including stock health, status trends, stock uniqueness, risks, potential effectiveness, existing and potential habitat quality and quantity, location and proximity to population centers, and current and potential future fishery benefits were considered.

On December 5, 1997, the Washington Fish and Wildlife Commission adopted the Wild Salmonid Policy (WFWC 1997). The goal of this policy is to “*protect, restore, and enhance the productivity, production, and diversity of wild salmonids, and their ecosystems to sustain ceremonial, subsistence, commercial, and recreational fisheries, non-consumptive fish benefits, and other related cultural and ecological values*”. The fishery and hatchery management principles that are detailed in the policy will serve as the framework for the recovery of wild steelhead in the LCSCI.

***Spawner Escapement:*** Sufficient escapement of appropriate naturally spawning steelhead will be provided to encourage local adaptation and maximize long-term surplus production that sustains harvest, and to provide for recreational opportunities and ecological benefits. WDFW will continue to pursue fishery management strategies that afford high levels of protection to both adult and juvenile steelhead. Fish management actions include:

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- Continue wild steelhead release fisheries to permit the harvest of hatchery steelhead while protecting wild steelhead.
  - Continue no trout stocking in anadromous waters to protect juvenile steelhead from incidental harvest in trout fisheries.
  - Modify trout fishing regulations as appropriate to avoid excessive mortality to juvenile steelhead that are caught in trout fisheries.
  - If spawner escapement goals are not achieved for three consecutive years, or if the five-year moving average of spawner abundance falls below 80% of the goal, a management/risk assessment will be performed to assess causal factors within six months.

**Genetic Diversity:** Genetic diversity within and among stocks will be maintained or increased to encourage local adaptation and sustain and maximize long-term productivity. Conditions will be created to encourage natural patterns of genetic diversity and local adaptation to continue. This will include efforts to assess and maintain stock sizes at levels consistent with minimum genetic stock abundance objectives outlined in the WSP (i.e., 3,000 divided by the average age of spawners). In addition, hatchery steelhead spawning in the wild can be a threat to the local adaptation, genetic diversity, and long-term productivity of wild steelhead. Therefore, the percentage of hatchery steelhead spawning with wild stocks will be limited to no more than 10% of the hatchery-wild composite except in cases where an approved hatchery intervention program has been specifically designed and implemented for the purpose of wild steelhead recovery. Currently, WDFW estimates that the percentage of hatchery spawners for most summer steelhead stocks exceeds 50%, and is over 30% for most winter steelhead stocks. Priority actions will be taken to reduce the percentage of hatchery spawners where needed. These actions include:

- Expand the use of adult trapping facilities to remove adult steelhead, after fisheries occur, to meet WSP targets. Trapped fish will be relocated to lakes to provide continued harvest opportunities, returned to the stream as carcasses to provide increased instream nutrient enrichment, and/or donated to food banks.
- Modify hatchery rearing and release strategies to decrease straying of hatchery spawners into wild production areas.
- Reduce hatchery stocking levels as appropriate to meet WSP guidelines regarding the percentage of hatchery steelhead spawning with wild steelhead.

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**Ecological Interactions:** Wild steelhead stock sizes will be maintained at levels that naturally sustain ecosystem processes, diverse indigenous species, and their habitats. Healthy populations of other indigenous species will be maintained within levels that sustain or promote abundant wild salmonid populations and their habitats.

- Reduce competition and predation to wild steelhead stocks by releasing only hatchery smolts that are ready to migrate.
- Expand the use of hatchery salmon and steelhead carcasses to restore instream nutrients to increase freshwater productivity for juvenile wild steelhead.
- Work with other state and federal agencies to determine the magnitude of the marine mammal, bird, and fish predation in the LCSCI area, and manage these species consistent with the recovery of wild steelhead populations.

**Harvest Management:** Fisheries will be managed consistent with objectives for wild steelhead spawner escapement, conservation of genetic diversity, and ecological interactions. The WDFW will work to limit the incidental harvest of wild steelhead to 10% on stocks not meeting escapement or genetic abundance goals and will be adjusted downward depending on spawning escapement. The incidental harvest will be measured in adult equivalents and will take into account incidental juvenile steelhead mortalities. These actions include:

- Continue wild steelhead release fisheries to permit the harvest of hatchery steelhead while protecting wild steelhead.
- Continue no stocking of trout in anadromous waters to protect juvenile steelhead from harvest in trout fisheries.
- Modify trout fishing regulations as appropriate to avoid excessive mortality to juvenile steelhead that are caught in trout fisheries.
- Work to modify commercial fisheries if needed to keep impacts to wild steelhead within acceptable levels to achieve steelhead protection and restoration.

**Cultured Production/Hatcheries:** Artificial production programs must be consistent with wild steelhead protection and recovery goals. Stable and cost effective artificial production programs will be used to provide significant fishery benefits while having no significant adverse impacts on the long-term productivity of naturally spawning steelhead and their ecosystem. Wild steelhead populations will be protected, rehabilitated, and re-established using hatcheries where appropriate by integrating genetic conservation, ecology, and fish management principles. The following depicts WSP guidelines for the compatible use of artificial production where wild salmonids occur:

Wild Salmonid Populations and Artificial Production Intervention
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1. Existing wild salmonid population has demonstrated the capability to replace itself on a sustained basis.	>>>	Intervention limited to harvest augmentation only. Adipose-fin mark, and no reliance for natural spawning augmentation.
2. Existing wild salmonid population does not presently have a demonstrated ability to replace itself on a sustained basis.	>>>	Intervention has the primary objective of providing effective naturally spawning fish. May be adipose fin marked.
3. Historic wild salmonid population no longer exists OR is too small to recover naturally following a fishery management action or habitat capacity change.	>>>	Intervention is temporary only for the specific objective of re-establishing natural selection processes. Intended result is a population capable of replacing itself on a sustainable basis.

- Continue to mark all hatchery steelhead for selective fisheries.
- Develop Hatchery Operation Plans to insure programs are consistent with achievement of spawner escapement, genetic diversity, and ecological interaction principles in the WSP.
- Continue the use of carefully designed and implemented hatchery strategies to protect and rebuild priority wild steelhead stocks.
- Evaluate the use of local wild fish for use as hatchery broodstocks to help protect against losses of genetic diversity and to reduce genetic risks associated with interbreeding between hatchery and wild fish.

### ***Management Emphasis***

The health of wild steelhead stocks will receive priority fish management attention with respect to protection and restoration actions. However, management emphasis on specific types of actions and priorities will vary. For fish management purposes, various approaches will be used, consistent with protection and restoration goals at various scales and NMFS guidance regarding “direct take” of listed species.

Some areas will be needed where management emphasis provides a high probability that adverse influences from human factors would be avoided, including the condition that hatchery steelhead would not be stocked. These areas may be considered “*reserves*” or “*sanctuaries*” as described further in the section below. Habitat quality may also receive priority attention in these areas.

At the other end of the spectrum, some river systems in the LCSCI area (e.g., Cowlitz and Lewis rivers) may have been altered to the extent that they could not be feasibly rehabilitated to sustain significant, naturally reproducing stocks without continual intensive human intervention. These situations present special cases in which the production and use of hatchery fish while applying conservation measures to reduce risks to remnant wild steelhead

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will be emphasized. Efforts to reintroduce anadromous fish above barriers and provide passage improvements will also be pursued. In these waters existing hatchery programs are substantial and the genetic and ecological risks of hatchery steelhead straying into neighboring river systems must be identified to develop appropriate conservation options. Fish culture operations will be reviewed in a long term effort to eliminate the occurrence of residuals and other undesired sources of ecological interactions risks to wild steelhead. In general, management flexibility and consideration of longer term issues and efforts will be needed, including modification to existing and future mitigation agreements.

For the remaining stocks and stream systems, important locally adapted and sustainable wild steelhead stocks exist. These will have priority stewardship objectives where protection and restoration of wild steelhead will be emphasized and management objectives will secondarily include a provision of recreational harvest of hatchery steelhead consistent with wild stock protection and restoration needs, and consistent with NMFS' guidelines regarding "take" of listed species.

### ***Fish Management Reserves or Sanctuaries***

Fish management reserves or sanctuaries may be an important component of the overall risk management and recovery strategies for wild steelhead in the LCSCI. The use of these areas is consistent with the intent to conserve genetic diversity as noted in the WSP. The concept is in some ways similar to that of "core areas" as outlined by NMFS (1996c) and as applied in the OCSRI (State of Oregon 1997), and the "key watershed" approach in the National Forest Plan (FEMAT 1993). To the extent these areas are utilized, more work will be needed to identify them and to assess complementary linkages between fish management and habitat approaches. The potential for use of reserves or sanctuaries in a habitat management context is discussed separately later in this chapter.

From a fish population dynamics and recovery perspective, the intent of these areas is not to broadly achieve numerical recovery goals but instead to provide a high level of certainty that the genetic integrity, biological diversity, and other unique qualities of existing steelhead resources in the LCSCI area are conserved with the least risk to stock health and long-term productivity as a result of fishery and hatchery factors.

Criteria for reserves would be intended to afford a base level of protection for a broadly representative spectrum of wild steelhead stocks in their habitats. Reserves would form a network of populations from which to restore genetic and life history diversity and local adaptations over the long term that might have been lost throughout the LCSCI area. Existing steelhead biodiversity would be emphasized and collective conservation actions would provide risk insurance to hedge against unforeseen future natural variation or human caused impacts. Hatchery steelhead would not be stocked in these areas, and efforts to preclude access by stray hatchery fish would receive priority attention. Spawning escapements for wild steelhead would be established at levels above MSY to afford a higher degree of protection and ecosystem benefits. Areas may be entire stream systems or large sections within streams. At a minimum these areas should include populations displaying unique features such as: genetic

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characteristics, size/age distribution, abundance, and populations that can access areas above falls that are a barrier to other anadromous salmonids. Although not an absolute condition of the designation from a fish management perspective, reserves in areas where steelhead habitat is of highest quality and quantity and the likelihood of maintaining it is greatest, would afford the highest levels of risk management.

The effectiveness of sanctuary areas will be complemented or enhanced if conservation designations and programs among resource management agencies for fish, wildlife, or other societal values were aligned. In a fish management context, the emphasis of sanctuaries would be on hatchery steelhead; areas where they are not released and where hatchery steelhead would be precluded from access. Added benefits would accrue if hatcheries for other species (trout or salmon) were absent, especially if this resulted in application of the sanctuary concept for an entire drainage and for multiple species.

It is intended that wild steelhead release fishing opportunities will be consistent with the sanctuary concept if stock health is adequate and undesired impacts on wild populations are effectively managed. Similar to stocks for which conservation actions will include management towards limiting the percentages of hatchery steelhead spawning with wild steelhead to a maximum of 10%, a provision of fishing opportunities in sanctuary areas (where the goal is to eliminate the presence of hatchery steelhead spawners) is contingent upon complying with NMFS' ESA guidelines associated with the potential for "direct take" of listed species.

Converting waters where hatchery steelhead are currently released into fish management reserves or sanctuaries would reduce harvest opportunity compared to the present, because the harvestable hatchery steelhead component would be eliminated. However, continued use of fishing regulations acceptable to NMFS should lead to improved wild stock health, and eventual designation of fisheries in which wild fish could also be harvested.

## **Habitat**

The identification and further development of actions to implement conservation strategies that address habitat factors for decline is a continuing effort. In contrast to the previous draft of the LCSCI, local, federal, and private actions are included in addition to state actions. Additional federal, local government and private actions will be included and more completely described in subsequent drafts of the LCSCI. Local government, private, and federal actions are essential to successful protection and restoration of steelhead, salmon, and trout stocks.

Several common themes and key ideas have emerged from strategies and actions considered to date which are summarized here. The habitat conservation strategies for all six factors for decline follow a similar pattern. Although there are variations for each factor, in general the strategies for all factors emphasize the need to:

1. assess the problem in greater detail to ensure solutions are tailored to the need;

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2. use assessment information to set priorities for action and ensure resources are used most effectively;
  3. use protection strategies that focus on building cooperation and partnerships and that can also rely on regulatory tools when needed;
  4. restore high priority degraded habitat through partnerships and incentives; and
  5. monitor the results of actions and any substantial changes in habitat conditions.

An essential prerequisite for ensuring the effectiveness of conservation actions is to assure that steelhead have access to needed habitat. This leads to an initial emphasis and priority given to identifying and correcting fish passage barriers to habitat, particularly those associated with roads and culverts. Many such barriers have been identified and can be corrected. Where habitat is already accessible or is made accessible, the other five factors for decline are more prominent.

Apart from barriers to fish passage, the other five factors for decline are very interrelated. The common element is the movement of water and the health or degradation of watershed functions. Conservation strategies and actions must be highly coordinated to ensure their effectiveness.

It is also apparent that most factors for decline are relevant throughout our watersheds; from the forested upper watersheds, through our rural and agricultural lowlands, to the urban, more densely developed areas of our lower watersheds and mainstem rivers. Conservation strategies must address forested, rural, and urban areas.

### ***Integrated Watershed Management***

Many of the habitat conservation actions by state, federal and local governments included in this LCSCI draft reflect a growing interest and involvement in watershed management that is integrated to address the interrelated issues of water quality, water quantity and availability, and protection and restoration of fish habitat.

In the State Salmon Strategy framework as drafted, the Joint Cabinet has recognized that watershed management groups funded by the state and organized by local governments will be the focal point for locally-based salmon protection and restoration efforts. There cannot be successful salmon and steelhead restoration without the full involvement of local government and other local interests. Federal, state, tribal, and local governments must work as partners in laying the local foundation for salmon and steelhead protection and restoration through local watershed management groups.

The Joint Cabinet is now working to ensure that state agencies provide coordinated support to local governments and others involved in integrated watershed management. Whatever statewide framework for integrated watershed management at the local level may be developed, state agencies need to provide coordinated assistance to local efforts in the areas of watershed characterization and assessment, data management and information transfer, technical and financial support for planning and implementation, and enforcement. Many of

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the state agency conservation actions in this LCSCI draft entail working at a watershed level in the LCSCI area and providing support to local watershed efforts. Many of the Phase 2 actions that have been proposed would be directed toward enhancing the state's capability to provide coordinated support to local watershed efforts.

The Washington Legislature is considering a bill (ESHB 2514) that would provide a statewide framework for integrated watershed management. In one of its versions the bill included findings that the development of integrated watershed management requires the support and involvement of local citizens and serves the state's fundamental interests by ensuring that water resources are used wisely, by protecting and enhancing water-related fish and wildlife habitat, by protecting existing water rights, by protecting instream flows for fish, and thus providing for the economic well-being of the state's citizens and communities.

The framework for integrated watershed management and the respective roles, responsibilities and capabilities of state and local government and other participants is evolving and will be further described and clarified in subsequent versions of the LCSCI. Integrated watershed management will be the means for ensuring that specific watershed functions and problems are understood and that habitat protection and restoration is achieved.

### ***Coordination for the Lower Columbia River and Estuary***

The Lower Columbia River Estuary Program (LCREP) as part of the National Estuary Program (NEP) is approximately half way through the process of developing a comprehensive conservation management plan for the lower Columbia River. The planning area includes the Columbia River from Bonneville Dam to the mouth, the Willamette River to Willamette Falls and the tributaries of the lower river to the head of tide. The program has identified seven key issues of concern on the lower river. These are: Habitat Loss and Modification, Conventional Pollutants, Toxic Contaminants, Biological Integrity, Public Awareness and Stewardship, Institutional Constraints and the Impacts of Human Activities and Growth. The plan when it is completed in July, 1999, will identify actions designed to address these broad problems and assign responsibility for implementation of the actions.

The Management Committee and Policy Committee of LCREP now are considering what the future role and stature of the program and management plan will be once the plan is completed. At the last meeting of the LCREP Management Committee in January, 1998, the group reached a general consensus on the future of the LCREP organization once the comprehensive plan is completed. Across a continuum of possibilities ranging from caretaker with minimal staff to aggressive authority with many staff, the committee envisioned an organization that would aggressively implement the plan but would not have regulatory authority. The organization would be a strong advocate for the river and have sufficient resources and political support to bring players to the table to ensure that coordination and cooperation occurs at all levels. The organization would take a lead role in some areas, monitor environmental trends, undertake studies, administer a public education program and be the focal point for policy development, dialog and dispute resolution.



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With this vision in mind, LCREP would be the body which ensures that the states of Washington and Oregon, the various federal, state and local agencies and the public and private sectors are all working together toward a common goal of protecting the resources of the lower river. With respect to the Lower Columbia Steelhead Conservation Initiative, this vision would address a number of the inter-jurisdictional coordination needs identified by the National Marine Fisheries Service in comments on the LCSCI Pre-Draft. Although LCREP is not yet in a position to assume this role, LCREP is beginning to build the support necessary to make this happen.

### ***Timber/Fish/Wildlife***

To address factors for decline in the forested areas of watersheds, the partners in Washington's Timber, Fish and Wildlife (TFW) process (Appendix 8) are taking a new look at the state's forest practices. The TFW partners have a strong track record of addressing forestry issues affecting fish and wildlife. TFW is currently negotiating modifications to the state Forest Practices Program. Topics to be negotiated include: forest roads, riparian management, upland harvest, watershed analysis improvements, water quality, restoration, monitoring and research. Many of the potential modifications are intended to enhance fish habitat protection. Products of successful TFW negotiations will become part of the LCSCI and will supersede the LCSCI if there are inconsistencies.

### ***Habitat Reserve Areas***

Restoration of wild steelhead stocks will require the protection and maintenance of currently functioning habitats and the improvement of degraded habitats. The application of a reserve or sanctuary concept in a habitat context may afford a means to protect, maintain, and restore functional habitat for selected areas of high importance to steelhead stocks. Again, as stated in the Fish Management section above, the intent of these areas is not to broadly achieve numerical recovery goals but instead to provide a high level of certainty that the genetic integrity, biological diversity, and other unique qualities of existing habitat supporting wild steelhead resources in the LCSCI area is conserved with the least risk to stock health and long-term productivity as a result of fishery and hatchery factors. The purpose of this subsection is to discuss the reserve concept for habitat under the LCSCI and to outline a proposed approach for its further consideration and development. This concept is consistent with the WSP FEIS (WDFW 1997a).

Application of the reserve concept is a fundamental component of efforts to conserve and manage specific at-risk species and biodiversity in general, and stems from the field of conservation biology. Conservation biology principles provide important guidance for restoration of salmonid species, to *protect healthy components, as well as provide necessary measures to restore weak stocks.*

For salmonids, this concept has been further refined to provide guidance for watershed restoration (e.g., FEMAT 1993; Frissell 1993; Noss and Cooperrider 1994; Li et al. 1995). An

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approach using reserves would include review of habitat types in watersheds based on their historic and present productivity. A plan would then be developed to prioritize and focus restoration efforts (see Chapter 16 - Monitoring and Evaluation, Appendix 6). Identification and protection of higher quality aquatic habitats and intact watershed processes are among the strategies needed for the habitat component of the LCSCI if a reserve approach for habitat is to be applied. This approach would be expected to provide a key risk management strategy supportive to wild steelhead production and habitat components of LCSCI conservation efforts over the long term.

The approach outlined here envisions that a high level of protection would be applied to a network of small to large sized subbasins or portions thereof, including areas of the lower Columbia River estuary. These areas would be selected based on their contribution to the productivity of wild steelhead stocks or for their importance to successful restoration of wild steelhead stocks. Candidate locations would be identified using scientific criteria, and would consider issues and recommendations from LCSCI partners, local community groups, and other entities. Once identified and implemented, these areas might receive priority funding attention and focused coordination with other LCSCI strategies and actions to ensure their maintenance.

Although full analysis is not complete, it is assumed that high quality habitat exists in the LCSCI area where a balance has been achieved between the maintenance of watershed functioning and the desired benefits derived from land uses. As steelhead restoration efforts proceed, it is envisioned that habitat improvements will occur in formerly degraded areas. However, effective restoration of wild steelhead and other salmonids will not be achieved until watershed functions improve. Improvement of watershed functions will only occur in concert with maintenance of other human needs and desires.

Many scientific and other issues and questions exist that will help address and guide future development of reserve concepts for the LCSCI. Some of these are related to Chapter 12 (Framework for Setting Priorities). Initial considerations include:

1. In the fish management subsection of this chapter, the use of areas protected from releases of hatchery fish was described. It may be desirable to have these areas be spatially similar to habitat reserve areas, for coordinated protection and restoration, although this is probably not an absolute requirement. For example, there may be some waters or river systems that currently contain a preponderance of hatchery steelhead now, that if restored in the future may have larger numbers of wild fish, thus making combined reserve status possible. In contrast, there may be waters in which hatchery fish are not stocked that are not high priority candidates for reserves from a habitat perspective. This is because the risk management focus may be different between fish management and habitat issues and needs.
2. The spatial scale of reserve design would need to consider the requirements of wild steelhead at all life history stages. However, not all life history requirements would need to

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be met in each reserve area. Instead, reserves and their connections would collectively form an integrated network to meet this need.

3. The extent of undisturbed habitat may be large (e.g., an entire basin or sub-basin) or small, such as a reach with good riparian and stream habitat characteristics.
4. Areas “adjunct areas” may have key value in reserve design. These areas would be near the healthiest wild fish stocks and would afford good potential for restoration and recolonization.
5. Salmonid populations within watersheds use habitats such mainstem floodplains at one or part of their life cycles. It will be important to consider the significance of these kinds of habitats as high priorities for protection and restoration.
6. The benefits of reserves for wild steelhead should consider complementary benefits for other at-risk species and stocks as well.
7. Delineation of habitat reserves should utilize a range of information and mapping processes. Features such as land use type, vegetation patterns, major land ownerships and management plans (e.g., Habitat Conservation Plans, watershed analyses, federal land (e.g., USFS Monument, Wilderness), water quality data including 303(d) (Appendix 5), and fish habitat information (especially noting higher gradient, for steelhead) should be included. Taken together this information would be compiled to help provide a landscape-oriented overview of candidate habitat reserve areas and help illustrate possible issues and inter-relationships. Maps showing reserve areas would be produced.

Examples of potential implementation opportunities include:

1. As noted in Chapter 16 and Appendix 6, the habitat component of the LCSCI monitoring plan includes development and implementation of a watershed assessment approach and baseline monitoring to evaluate habitat condition and restoration needs and progress in the LCSCI area. This approach and related information will provide important linkages to identification and assessment of candidate reserve sites, and long term monitoring of their condition and utility.
2. Locations of habitat reserves should be determined on a local basis where they meet specific criteria, and by following a specified scientific protocol for the initiative area as a whole. Development of specific criteria and/or protocols remain to be completed.

### **Tributary Dams/Hydropower**

Major dam projects in the LCSCI area exist in the Lewis and Cowlitz river systems, with smaller projects in other areas (e.g., Trout Creek in the Wind River subbasin). Dams and hydroelectric projects can have major interacting impacts on steelhead and other fish within a watershed. Blockages to fish movement can isolate the upper watershed from the lower

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watershed. These blockages and factors like inundation of habitat remove the upper watershed from production. Multiple measures are often needed to achieve mitigation and restoration at dams. The Federal Energy Regulatory Commission (FERC) relicensing process is an ongoing opportunity to mitigate impacts caused by hydroelectric projects. Smaller dams have lesser impacts than suites of storage dams, and remedies for the impacts of the smaller dams are simpler.

As in the LCSCI in general, restoration measures involving dams and hydropower includes analysis and planning, implementation, and monitoring. Watershed analysis and planning are important steps in restoration, identifying projects that will have the greatest benefits to fish because of feasibility and effectiveness. Implementation requires a financial commitment. Monitoring is needed to ensure that measures are implemented according to plan. Monitoring also is needed to determine if steelhead stocks are responding as expected to restoration measures (see Chapter 16 and Appendix 6).

Restoration measures in both the Lewis and Cowlitz river basins will be based on coordinated basin assessments to address multiple impacts from multiple projects, in the context of FERC relicensing. Both efforts will develop over a longer and slower timeline than the LCSCI process, and neither is oriented toward problems experienced exclusively by steelhead. However, the steelhead plan can benefit from work done through FERC discussions and processes. The assessment phases of planning have commenced in each basin as part of consultation for FERC relicensing and are listed as Phase 1 measures in this document. Implementation of restoration measures in coordinated basin planning will be Phase 2 measures, as well as being FERC license conditions for mitigation. In the upper Cowlitz River basin, a steelhead reintroduction effort has begun using hatchery strategies. That effort uses a stock presumed to be similar to and descended from the native stock of the upper watershed. In the Lewis River basin PacifiCorp has committed to contributing to restoration and enhancement measures in tributaries that are now accessible to steelhead. More detail on that project is presented in Appendix 7.

Operational changes such as **fish passage, improved base flows and less disruptive water release schedules** at dams are expected to yield significant benefits to fish. Management measures range from installing and upgrading fish **screens** and ladders to implementing minimum in-stream flow releases. Gradual ramping of reservoir levels and regulation of water temperature and dissolved oxygen and other gas levels also help mitigate the impacts of dams to steelhead. Off-site measures may be needed to mitigate for unavoidable losses, such as lost riparian and lost free-flowing habitat. Although dam removal and site restoration may be the most effective option for restoring fish at a project, removal of the large hydroelectric complexes on the Lewis and Cowlitz rivers is not anticipated. Conservation measures should be regarded as mitigation for ongoing impacts of projects. Probable types of mitigation measures to be recommended or required as part of a new FERC license will include:

- smolt collection facilities at multiple locations and transport and release of fish below dams,
- improved screening of intakes in conjunction with smolt collection facilities,
- trap-and-haul to move fish around entire an complex of dams and reservoirs,

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- transportation and distribution of salmon carcasses from hatcheries to tributaries,
  - continued emphasis on replacement of losses with hatchery production, including upgrading to achieve mitigation obligations, while managing hatchery fish to minimize adverse ecological and genetic effects on wild populations,
  - achieve instream flows and ramping rates recommended by time of year and time of day,
  - modify dam spillways to reduce gas supersaturation,
  - increase flow rate through reservoirs, and
  - use a managed stage/rule curve to avoid stranding fish.

At Hemlock Dam on Trout Creek, a Wind River tributary, the U.S. Forest Service, the dam owner, will improve upstream and downstream passage for steelhead. Passage improvement is being achieved through improved fish ladder attraction flow and screening (Phase 1), with a possibility of removing the dam as a Phase 2 measure.

Smolt survival decreases as the concentration of suspended sediments (NFSS) increases in the North Fork Toutle River. Smolts outmigrating later, in April - May, when NFSS loadings are lower, survive to return in greater numbers than early migrating smolts. A potential Phase 1 measure, managing the North Fork Toutle River Sediment Retention Structure Project (SRS) to reduce NFSS concentration in the lower river during the most fish-sensitive times of the year would entail Congressional action and would require a request by WDFW to Congress. Sediments could be trapped and removed from suspension during the juvenile outmigration season in the lower Toutle and Cowlitz Rivers. This sediment sump could be maintained through the spring, summer, and early fall by using high flows to flush sediments from the sump and out of the lower Toutle River. Adult and juvenile salmonid passage and rearing conditions in the lower river would improve. Cowlitz River flow releases from Mayfield Dam could be regulated in concert with Toutle River high flows to increase fine sediment transport from the confluence of these rivers to the Columbia River. Monitoring NFSS with Standard Field Bioassay (LC50, 96 hour) should provide guidance for SRS sediment management in order to protect upper North Fork Toutle and Lower Cowlitz River wild salmonid outmigrants.

Although the emphasis is on tributary dams, it is important to acknowledge the substantial impact of the one mainstem dam present in the LCSCI area. Bonneville Dam on the mainstem of the Columbia River creates a major adverse impact to steelhead in the upper part of the LCSCI area, including the Wind River in Washington. Bonneville Dam affects steelhead by hindering passage upstream and downstream, creating increased predation risks, and causing high levels of dissolved gases below the dam. Possible mitigation measures include improvement of upstream and downstream fish passage and screening and reduction of gas supersaturation by spillway modification. Conservation issues and measures to address mainstem dams are of key interest to a very wide range of parties since mainstem dams have an influence on many species and stocks in the Columbia River basin. Various interagency forums and groups are currently working on the issues and the LCSCI will rely on those processes to address priority concerns.